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# Milk Production and Fatty Acids Balance of Dairy Goat Fed Diet with Fermented *Durio zibethinus* Peel

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## ABSTRACT

The by-product of Durio fruit is huge potential biomass to be utilized as a feed ingredient. However, it needs to be treated physically and biologically such as by fermentation. The objectives of this study were to evaluate nutrient contents, nutrient intakes, nutrient digestibility, milk yield, milk composition, and fatty acid contents in concentrate, milk, and feces of dairy goat fed the diet with a concentrate containing fermented Durio peel flour. The backlogs containing a mixture of Durio peel flour, rice bran, and CaCO3 were fermented with *Pleurotus ostreatus* for two weeks, air dried, then were ready to be formulated in concentrate. Treatments were FDC 0: basal diet of 55.7% tofu- by-product + 44.3% composite forage; FDC 5: basal diet + Concentrate with 5% fermented Durio peel +25% rice bran; FDC 10: basal diet + Concentrate with 10% fermented Durio peel +20% rice bran; FDC 20: basal diet + Concentrate with 20% fermented Durio peel + 10 rice bran. The experimental design used was a completely randomized design in 4 x 4, 4 treatments, and 4 replications in 40 days. Therefore, there were 16 lactating Nubian crossed goats as experimental units. Results showed there was found that the 5% fermented Durio peel flour in concentrate showed several consistency in some quality. Those were high in crude protein, ether extract, dry matter intake, gross energy, digestibility of nutrients (dry matter, organic matter, ether extract, crude protein, crude fiber, N-free extract, gross energy), milk yield, ECM, MCFA, LCFA, PUFA in milk, C<16, C>16, unsaturated, a total fatty acid in concentrates, milk, and feces. There were low SCC in milk and low n-6/n-3 in milk that were expected. Therefore, the 5% fermented Durio peel flour and 25% of rice bran in concentrate was considered optimal for lactating dairy goat.

**Keywords**: balance, *D. zibethinus*, fatty acid, fermented

## INTRODUCTION

The potency of the by-product of *Durio zibethinus* Murr (seed and peel) in Indonesia is huge as this plant is growing well in most places. The production of this fruit all over provinces in Indonesia is 735,423 ton, while, in Bengkulu is 12,999 ton in the year of 2016 as reported by BPS (2016). With this fruit production nationwide, there are some by-product biomass potencies of Durio peel (497,954 tons) equals 67.71%. Out of this peel or peel, it could be processed as white inner peel flour as much as 186,484 tons equals 37.45%; while in this province it can potentially produce 3,297 tons. This biomass is an alternative as feedstuff, however, it needs to be pretreated to reduce its high fiber content. Fermentation can be considered as an effort that is a suitable technology for this purpose.

Besides fermented Durio peel flour, in concentrate, other feedstuffs such as ground corn, soybean flour also corn oil were composed as PUFA sources and expected to bypass rumen so that reduce biohydrogenation in dairy goats and dairy cows. Supplements such as yeast and *Curcuma xanthorrhiza* were incorporated into the concentrate. Yeast is helping improved metabolism in the rumen; at the same time, Curcuma could inhibit protozoa growth in the rumen. Therefore the combination of 5 g yeast and 20 g *Curcuma xanthorrhiza* in PUFA concentrate tended to have lower milk fat, 4% FCM, protein, dry matter, and solids non-fat, but it showed higher lactose, and Ca percentages (Sulistyowati *et al.*, 2014). Yeast supplementation was reported to improve DMI, milk yield, milk fat, organic matter digestibility (Desnoyers *et al.*, 2009), and increased omega-3 in the milk of a dairy cow (Yalçın *et al.*, 2011).

The type and quantity of fatty acid of the product have been a concern for health reasons. Therefore, the fatty acid content in the feed that is consumed by dairy cows or dairy goats will eventually determine its fatty acid content in the product, such as in milk. After metabolizing fatty acid contents in the feed, incorporated in milk, then some as disposed of in feces. Therefore it can be calculated the digestibility of fatty acid consumed. Rico *et al.* (2014) reported that supplementation of palmitic acid in short term did not increase milk yield, fat, and protein levels, yet, did improve C-16 fatty acid in milk, C-16 fatty acid apparent digestibility, and total fatty acid in milk. Supplementation of 5 g yeast and 20 g Curcuma in dairy goat fed a diet containing PUFA concentrate showed high in monounsaturated fatty acid (MUFA); while it was low in short-chain fatty acid (SCFA), n6/n3 ratio, and atherogenicity index (Sulistyowati *et al.*, 2013).

The objective of this current experiment was to evaluate nutrient quality consisting of nutrient contents and gross energy. *In vivo* evaluation including nutrient intakes, nutrient digestibility, milk components, somatic cell count, the fatty acid content in concentrates, milk, and feces, and fatty acid digestibility of diet with a concentrate containing fermented Durio peel flour in dairy goat was conducted as well.

## MATERIALS AND METHODS

### Preparation of *Durio zibethinus* peel flour fermentation and other feed ingredients

The *Durio* peel was collected, removed its hard spikes of the outer part, left its white inner part. This white part then was thinly sliced, dried under the sun, then ground became coarse flour. This material was composted by soaking it in water for two days then air-dried. This Durio peel flour compost was then prepared in 600g/backlog containing a mixture of 13% rice bran, 85% fermented *Durio*, and 2% CaCO3, sterilized at 1200C for 4 hours, let them settled in about 400C, then inoculated with 0.5% *Pleurotus ostreatus* starter. This procedure was modified from the previous experiment conducted by Sulistyowati *et al.* (2018).

Yeast additive was prepared from several ingredients (fresh cassava tuber, rice flour, garlic, lime, sugar, Alpinia *galanga*, local commercial yeast, and water) with a certain ratio based on a modification of the procedure of Pusbangtepa (1981). *Curcuma xanthorrhiza* powder was bought from the local market as it was readily available or otherwise could be prepared. It was started from peeling off the skin of the Curcuma, slicing thinly, drying, and peeling it as powder. Ground corn and soybean flour were roasted until turned light brown. Together with palm oil, these feed ingredients were designated as polyunsaturated fatty acid (PUFA) sources.

### Experimental design and treatments

The experiment was conducted in a completely randomized design with four treatments as follows, in four replications as experimental units. Data were tabulated and statistically analyzed in Anova, any significant differences were further tested using Duncan's Multiple Range Test according to Lentner and Bishop (1986). The duration of the experiment was 2 weeks of pretreatment and 4 weeks of treatment.

FDC 0: basal diet of 55.7% tofu- by product + 44.3% composite forage
FDC 5: basal diet + Concentrate with 5% fermented Durio peel +25% rice bran
FDC 10: basal diet + Concentrate with 10% fermented Durio peel +20% rice bran
FDC 20: basal diet + Concentrate with 20% fermented Durio peel + 10 rice bran

The FDC (fermented Durio concentrate) compositions were the addition of each fermented Durio peel flour treatment into concentrate containing 30% ground corn, 32% soybean flour, 4% palm oil, 0.5% mineral mix, 1% Curcuma *xanthorrhiza*, 1% yeast, 0.5% NaCl, 0.5% CaCO3, and 0.5% TSP. The basal diet consisted of 55.7% tofu by-product and 44.3% composite forage. The composite forage consisted of 44% *Indigofera* sp, 40% *Gliricidia sepium*, 16% *Calliandra calothyrsus*. The fermented Durio concentrate was provided for 1.5 kg/day, half was given in the mornings and another half-fed in the afternoons for each goat. There were 16 lactating dairy goats (Nubian crossed) with an initial average body weight of 53.5 kg ± 9.30 kg and final body weight of 58 kg ± 11.40 kg. Milk productions were 1.59 ± 0.085 kg/d and 1.31±0.38 kg/day in the beginning and at the end of the experiment, respectively as the lactation phage was progressing. The pretreatment was 10 days and the treatment lasted for 30 days, all together was 40 days.

### Chemical Analyses of Nutrients, Fiber Fraction, and Fatty Acids

Proximate analyses were performed to evaluate the nutrition of four treatments, three concentrates containing fermented Durio peel flour and goats' feces. The nutrient analyses performed were dry matter, organic matter, crude protein, ether extract, and crude fiber contents according to AOAC (2005) and gross energy using Bomb calorimetry. The N- free extract (NFE) was a calculation of 100% - (% ash + % crude protein + % crude fiber + % ether extract).

Fatty acids identified as fatty acid methyl ester (FAME) were analyzed after extraction of milk fat, concentrate fat, and feces fat samples according to AOAC (2012). Using GC- FID, 2010 Plus, Shimadzu, Japan, separation, and quantification of the FAME was conducted. Fatty acids were classified as follows: C<16 consisting of short-chain and medium-chain fatty acid, and long-chain fatty acid (C>C16), polyunsaturated fatty acid (PUFA), and SCFA (C< 10), MCFA (C12-C16), LCFA (C>C16) in milk, the ratio of n6/n3: (linoleic acid + arachidonic acid)/linolenic acid (Schmidely *et al.*, 2005).

### Data Collections and Analysis

Feeds (tofu-byproduct, forage, and fermented Durio concentrate) were provided twice a day, mornings and afternoons. Orts of feed were weighed in the mornings. Feces were collected in the last seven days of treatment, weighed and dried then tested for proximate and fatty acid analysis. Then, nutrient intakes and digestibility were calculated.

Milk yields were weighed and measured then recorded after each milking in the mornings and afternoons. Milk samples of each experimental unit were collected on the last day of treatment then kept frozen until the time of analysis of milk composition (fat, protein, lactose) using Lactoscan, SCC (somatic cell count), and fatty acids. Energy corrected milk (ECM) was calculated as (0.327 x milk kg/d) + (12.95 x fat kg/d) + (7.65 x protein kg/d) as reported by DRMS (2014). Efficiency of milk yield and dry matter intake (DMI) was calculated as milk yield/DMI and ECM/DMI. Fatty acid balances were grouped in concentrate, milk, feces and calculated for their amounts (g) and digestibility (%).

## RESULTS AND DISCUSSIONS

### Nutrient contents

Nutrient contents, especially for dry matter, organic matter, ether extract, crude protein, N-free extract, and gross energy decreased with the increasing level of fermented Durio- peel flour (Table 1). On the other hand, crude fiber was increasing with the higher level of fermented Durio-peel flour. These results determine that the higher the fermented Durio peel flour, meaning the lower the rice bran as a substitution in concentrate, the lower the nutrition contents that can be provided in the diet.

The crude fiber was higher with an increasing level of fermented Durio peel flour (20%). However, these three levels of fermented Durio were lower in crude protein compared to a diet with no fermented Durio peel flour (FDC0). This higher crude protein and crude fiber were due to tofu by-product and composite forage nutrient contents, respectively. Among the three levels of fermented Durio peel flour in diets, the 5% level (FDC5) was considered optimal in terms of higher ether extract and N-free extract, and lower crude fiber. Another experiment using Durio seed meal showed that 20% level was optimal for nutrient content in concentrate for the dairy cow as reported by Sulistyowati *et al.* (2019b). The crude protein content required for a dairy goat with a 50 kg body weight producing 3 kg of milk is 13.5% (NRC, 1981). Therefore, this 5% fermented Durio peel flour in concentrate of a diet was fulfilling the requirement.

Table 1. Nutrients compositions of diet with concentrate containing fermented Durio peel flour for dairy goat

| Nutrients | FDC0 | FDC 5 | FDC 10 | FDC 20 |
|---|---|---|---|---|
| Dry matter, % | 89.18 | 87.71 | 84.93 | 79.67 |
| Organic matter, % | 85.41 | 80.66 | 78.17 | 73.30 |
| Ether extract, % | 7.92 | 12.62 | 10.91 | 8.20 |
| Crude protein, % | 19.00 | 15.62 | 16.22 | 12.42 |
| Crude fiber, % | 18.24 | 6.41 | 6.98 | 10.38 |
| N-Free extract,% | 40.25 | 46.01 | 44.06 | 42.29 |
| Gross energy, cal/g | 4520 | 4426 | 4631 | 4222 |

**Nutrient intakes and digestibility**

In general, averages of nutrient intakes were higher in the three levels of fermented Durio peel flour diets compared to basal diet (FDC0) (Table 2). Especially, dry matter intake (DMI) of fermented Durio treatments was very significantly higher ($p$<0.01) compared to that of basal diet. This was as the effect of concentrate provided in the treatments, therefore there were more intakes in all nutrients compared to the basal diet, with no fermented Durio concentrate. The DMI on this current experiment was in the range of 3.9- 4.3% of body weight. This range has complied with the requirement for 50 kg body weight and 3.0 kg milk was 3.85% of the bodyweight of dairy goat (NRC, 1981).

Nutrient intakes (especially crude protein) and digestibility of crude protein (62.4%) of the diet with alfalfa hay were reported higher compared to rice straw (Wang *et al*., 2014). This digestibility was about within the range of that in the basal diet in this present experiment, while the fermented Durio diets, the digestibilities were much higher. This implied that the fermented Durio diets were much easier to be digested than composite forage or Alfalfa hay. Another by-product of Durio, that is seed was also tested as an ingredient in concentrate for the dairy cow. Digestibility of all nutrients in treatment diets was also very significantly higher ($p$<0.01) compared to that of basal diet. However, among the three fermented Durio, there were remained the same in most nutrient digestibility, except for crude fiber that was the highest ($p$<0.01) in the 20% fermented Durio diet. Other experiments with 27.5% Durio seed meal in concentrate showed an optimal level of nutrient digestibility in dairy cows (Sulistyowati *et al*., 2019b). All nutrient intakes and digestion, except crude fiber, found higher in averages was in the 5% fermented Durio diet. The level of 5% fermented Durio peel flour and 25% rice bran in concentrate was considered the optimal one provided in the diet of dairy goats.

**Milk yield, milk compositions, and milk efficiency**

Milk yield, milk composition, and milk efficiency of all treatments were not significantly different ($p$>0.05) (Table 3). However, on average, milk production of 5% fermented Durio peel flour diet was 0.54 kg/d higher than a basal diet with no fermented Durio peel flour concentrate. Milk fat of basal diet and 20% fermented Durio peel flour concentrate tended to be higher than those in 5% and 10%. These might be due to the higher contents of fiber in the composite forage of the basal diet and the highest fermented Durio peel flour. The SCC found the lowest was in 5% fermented Durio peel flour. It was about half of those in 10% and 20% fermented Durio peel flour and about 68.05% of that basal diet. Milk yield and milk composition were reported not affected by supplementation of slow-release urea, micro-bial yeast, and a combination of both (Neal *et al*., 2014).

Table 2. Intakes and apparent digestibility of nutrients of diet with concentrate containing fermented durio peel flour in dairy goat

| Variable | FDC 0 | FDC 5 | FDC 10 | FDC 20 | SEM |
|---|---|---|---|---|---|
| Intakes (g/d) | | | | | |
| Dry matter | 1137.60$^{a}$ | 2307.92$^{b}$ | 2262.20$^{b}$ | 2168.71$^{b}$ | 66.53 |
| Organic matter | 1708.01 | 3318.52 | 3223.65 | 2973.35 | 56.84 |
| Ether extract | 90.10 | 182.90 | 179.33 | 171.93 | 5.25 |
| Crude protein | 379.02 | 536.64 | 537.87 | 477.80 | 12.50 |
| Crude fiber | 365.34 | 407.50 | 402.96 | 433.96 | 11.56 |
| N- free extract | 457.21 | 1044.94 | 976.87 | 906.31 | 26.58 |
| GE (Mcal/kg) | 5,061 | 11,316 | 11,046 | 9,387 | 0.275 |
| Digestibility (%) | | | | | |
| Dry matter | 59.79$^{a}$ | 80.99$^{b}$ | 76.67$^{b}$ | 80.67$^{b}$ | 1.64 |
| Organic matter | 68.24$^{a}$ | 83.70$^{b}$ | 80.41$^{b}$ | 83.28$^{b}$ | 1.59 |
| Ether extract | 83.45$^{a}$ | 94.25$^{b}$ | 91.35$^{b}$ | 92.13$^{b}$ | 0.86 |
| Crude protein | 68.26$^{a}$ | 82.68$^{b}$ | 80.97$^{b}$ | 81.62$^{b}$ | 1.71 |
| Crude fiber | 62.57$^{a}$ | 65.22$^{b}$ | 64.27$^{b}$ | 74.40$^{c}$ | 2.89 |
| N- free extract | 61.06$^{a}$ | 85.85$^{b}$ | 78.71$^{ab}$ | 81.50$^{b}$ | 1.48 |
| GE | 65.07$^{a}$ | 82.44$^{b}$ | 80.90$^{b}$ | 79.77$^{b}$ | 1.44 |

Means of treatments with different supercript. differ very significantly ($p$<0.01)

Table 3. Milk production, milk quality, and milk efficiency of diet with concentrate containing fermented durio peel flour in dairy goat

| Variable | FDC 0 | FDC 5 | FDC 10 | FDC 20 | SEM |
|---|---|---|---|---|---|
| Milk yield (kg/d) | 1.06 | 1.60 | 1.55 | 1.42 | 0.18 |
| Fat (%) | 6.59 | 4.93 | 4.90 | 5.55 | 1.09 |
| Protein (%) | 3.82 | 3.56 | 3.30 | 3.65 | 0.26 |
| Lactose (%) | 3.66 | 3.39 | 3.33 | 3.54 | 0.22 |
| Ash (%) | 0.60 | 0.56 | 0.54 | 0.58 | 0.04 |
| Fat (kg) | 0.070 | 0.079 | 0.076 | 0.079 | 0.025 |
| Protein (kg) | 0.040 | 0.057 | 0.051 | 0.052 | 0.014 |
| Lactose (kg) | 0.134 | 0.115 | 0.111 | 0.125 | 0.106 |
| SCC ($10^3$/ml) | 2.410 | 1.640 | 3.880 | 3.290 | 2.078 |
| ECM | 1.55 | 1.90 | 1.84 | 1.82 | 0.47 |
| Milk efficiency: | | | | | |
| Milk yield/DMI | 0.92 | 0.67 | 0.67 | 0.64 | 0.22 |
| ECM/DMI | 1.38 | 0.82 | 0.81 | 0.84 | 0.35 |

Other treatments with Durio seed meal as much as 27.5% and 20% rice bran in concentrate produced more milk, about 1 k/d higher compared to other lower or higher levels of Durio seed meal in the dairy cow as reported by Sulistyowati *et al*. (2019c). Energy corrected milk (ECM) of three fermented Durio peel flour diets were about the same. Milk efficiency (ECM/DMI) in this present results in fermented Durio diets were <1. Another result with palmitic acid treatment was reported 1.29-1.53 as reported by Rico *et al.* (2014). Milk efficiencies of treatments with urea, yeast, and their combination were relatively the same in the range of 1.46-1.61 as reported by Neal *et al.* (2014). However, the 5% fermented Durio peel flour diet was about 122.58% higher than that of the basal diet. Meaning, it contained more energy than other treatments. Milk efficiency in the basal diet was higher on average compared to three other levels of fermented Durio peel flour diets. This basal diet produced more milk per kg DMI. Based on high milk yield, high ECM, and low SCC content, the 5% fermented Durio peel flour diet was considered optimal level for dairy goats.

**Fatty Acid Profiles**

Fatty acid contents of concentrates containing fermented Durio peel flour were reported previously (Sulistyowati *et al.*, 2019a). Results reported that total fatty acids out of dry matter contents were 2.95, 1.59, and 0.97 % for 5, 10, and 20% of fermented Durio peel meal, respectively. These indicated that the higher the level of fermented Durio, the lower the total fatty acid contents in concentrate. This implied that the fermentation process on Durio peel flour was fine, but the amount of this ingredient affected the total fatty acid metabolism of concentrate.

To improve the contents of fatty acid, especially PUFA, roasting soybean flour and ground corn is an effort. Chouinard *et al.* (2001) reported that roasted soybean yielded higher fatty acids of C18:1, C18:2, and C18:3. Heating made the oil produced by the ingredients would be available after bypassing rumen biohydrogenation. This present result, it showed that the 5% fermented Durio peel flour incorporated in concentrate containing roasting of soybean flour and ground corn contained high in C18:0, C18:1n9c, and C18:2n6c as reported by Sulistyowati *et al.*, (2019a). Therefore, 5% fermented Durio peel flour and 25% rice bran was considered much better in term of total fatty acid.

Milk fatty acid contents of dairy goats fed the three fermented Durio were relatively unaffected (Table 4). However, on averages, these three fermented Durio had higher (even though not significantly different) contents of SCFA, MCFA, and SFA and lower LCFA and PUFA compared to those of basal diet. The fermentation caused more saturation of fatty acid in milk, compared to a basal diet with tofu by-product and composite forage only. An experiment was reported that supplementation of antioxidants into PUFA diet containing 15% dried distiller grain showed no differences in SCFA, MCFA, and C:18 in dairy cow milk compared to those with no antioxidant; a slight increase was found in C:16 (Boerman *et al.*, 2014). Further stated that the sources of fatty acid were de novo, preformed, and mixed which were not affected by this supplementation. The SFA and MCFA were mostly synthesized in the mammary gland (de novo FA), the LCFA will affect this process, moreover, if this is more unsaturated (Chilliard *et al.,* 2003). Based on the lower SCFA, high LCFA, and average PUFA, the 5% fermented Durio peel flour in concentrate are reasonable to be provided for dairy goats.

Fatty acid profile in concentrates with fermented Durio peel flour contained C<16 lower than the C>16 (Table 5). The higher the level of fermented Durio peels flour, the lower the unsaturated fatty acid in concentrates. This means that the fermentation of *Pleurotus ostreatus* of Durio peel and the amount of this ingredient made the feed more saturated. On the other hand, ratios of n-6/n-3 increased with increasing levels of fermented Durio peel flour. This implied that fermentation of Durio peel flour and its amount decreased n-3 fatty acid. Total fatty acid in 5% fermented Durio peel flour in concentrate was high among treatments, even compared to the basal diet.

Table 4. Fatty acid contents of milk of dairy goat fed diet with concentrate containing fermented Durio peel flour

| Fatty acids (%) | FDC 0 | FDC 5 | FDC 10 | FDC 20 | SEM |
|---|---|---|---|---|---|
| Butyric Acid, C4:0 | 0.39 | 0.51 | 0.50 | 0.47 | 0 .15 |
| Caproic Acid, C6:0 | 0.62 | 0.77 | 0.82 | 0.75 | 0.12 |
| Caprilic Acid, C8:0 | 0.96 | 0.99 | 1.18 | 1.10 | 0.19 |
| Capric Acid, C10:0 | 3.88 | 4.31 | 4.71 | 4.51 | 0.79 |
| Undecanoic Acid, C11:0 | 0.06 | 0.08 | 0.07 | 0.07 | 0.03 |
| Lauric Acid, C12:0 | 1.545 | 1.62 | 1.56 | 1.60 | 0.37 |
| Tridecanoic Acid, C14:0 | 0.03 | 0.04 | 0.04 | 0.05 | 0.02 |
| Myristic Acid, C14:0 | 4.37 | 5.50 | 5.02 | 5.33 | 1.61 |
| Pentadecanoic Acid, C15:0 | 0.46 | 0.39 | 0.43 | 0.44 | 0.08 |
| Palmitic Acid, C16:0 | 16.93 | 20.29 | 18.93 | 19.77 | 1.29 |
| Palmitoleic Acid, C16:1 | 0.53 | 0.42 | 0.39 | 0.49 | 0.09 |
| Heptadecanoic Acid, C17:0 | 0.26[a] | 0.20[b] | 0.21[b] | 0.22[b] | 0.02 |
| Cis-10-Heptadecanoic Acid, C17:1 | 0.1[a] | 0.07[b] | 0.06[b] | 0.08[b] | 0.02 |
| Stearic Acid, C18:0 | 12.95 | 12.26 | 14.86 | 12.78 | 2.83 |
| Oleic Acid, C18:1n9c | 2249 | 21.45 | 18.40 | 20.28 | 1.85 |
| Linoleic Acid, C18:1n6c | 6.74 | 5.24 | 5.48 | 5.25 | 1.08 |
| Arachidic Acid, C20:0 | 0.13 | 0.14 | 0.11 | 0.15 | 0.03 |
| y-Linoleic Acid, C18:3n6 | 0.04 | 0.03 | 0.06 | 0.03 | 0.04 |
| Linoleic Acid, C18:3n3 | 0.64 | 0.52 | 0.40 | 0.50 | 0.16 |
| Cis-11, 14-Eicosedienoic Acid, C20:2 | 0.04[a] | 0.04[a] | 0.02[b] | 0.04[a] | 0.01 |
| Behenic Acid, C22:0 | 0.04 | 0.04 | 0.04 | 0.04 | 0.01 |
| Arachidonic Acid, C20:4n6 | 0.11 | 0.08 | 0.10 | 0.10 | 0.01 |
| Short chain FA (SCFA) | 5.85 | 6.58 | 7.21 | 6.83 | 0.79 |
| Med chain FA (MCFA) | 6.47 | 7.64 | 7.10 | 7.48 | 0.89 |
| Long chain FA (LCFA) | 60.96 | 60.78 | 59.05 | 59.72 | 7.21 |
| Saturated FA (SFA) | 16.93 | 20.29 | 18.93 | 19.77 | 2.46 |
| PUFA | 0.815 | 0.67 | 0.58 | 0.66 | 0.09 |

Different superscripts of means in the same row, different significantly ($p$<0.05)

Table 5. Fatty acids composition of concentrate, milk, and feces diet with concentrate containing fermented Durio peel flour in dairy goat

| Fatty acid (% of fat) | FDC 0 | FDC 5 | FDC 10 | FDC 20 | SEM |
|---|---|---|---|---|---|
| Concentrate | | | | | |
| C<16 | 10.13 | 15.67 | 13.33 | 16.63 | |
| C>16 | 36.21 | 38.22 | 30.45 | 25.04 | |
| Unsaturated | 31.34 | 33.55 | 26.10 | 20.32 | |
| n6/n3 | 1.88 | 0.93 | 1.27 | 2.33 | |
| Total FA | 38.67 | 53.89 | 43.79 | 41.66 | |
| Milk | | | | | |
| C<16 | 29.77 | 34.92 | 33.63 | 34.57 | 3.34 |
| C>16 | 43.51 | 40.08 | 39.73 | 39.46 | 3.86 |
| Unsaturated | 30.14[a] | 27.44[b] | 24.5[b] | 26.27[b] | 1.71 |
| n6/n3 | 10.83 | 10.29 | 14.18 | 10.86 | 2.31 |
| Total FA | 73.29 | 75.07 | 73.37 | 74.02 | 2.46 |
| Feces | | | | | |
| C<16 | 3.09 | 3.52 | 3.91 | 3.59 | |
| C>16 | 16.20 | 16.11 | 18.51 | 16.90 | |
| Unsaturated | 3.03 | 2.04 | 1.85 | 2.36 | |
| n6/n3 | 10.25 | 11.00 | 8.40 | 8.50 | |
| Total FA | 19.43 | 19.78 | 22.54 | 20.61 | |

Different superscripts of means in the same row , different very significantly ($p$<0.01)

Milk fatty acid of dairy goat fed the three levels of fermented Durio peel flour contained low C<16 but high in C>16. However, the basal diet contained lower in C<16 and higher in C>16 compared to the other three treatments. These results were the opposite of those found in the milk of dairy cows fed different levels of fermented Durio peel flour in concentrate. The C<16 was found higher in the milk of dairy goat fed PUFA-diet with no additive in the milk of dairy goat fed PUFA-diet with no additive as reported by Sulistyowati *et al.* (2013). Unsaturated fatty contents of milk of dairy goat fed fermented Durio peel flour in concentrate significantly lower ($p$<0.05) than those of basal diet.

Among the three treatments, there tended to decrease the unsaturated fatty acid in milk with increasing level (10%) of fermented Durio peel flour in concentrate. These were in coincidence with decreasing unsaturated fatty acid with increasing levels of fermented Durio peel flour. Other results with yeast supplementation showed higher in C<16 fatty acid as reported by Hristov *et al.* (2010). The n6/n3 ratio in this dairy goat milk was found low in the 5% fermented Durio peel flour diet. These ratios were much higher compared to those with flaxseed treatment as reported by Cortes *et al.* (2010). These all n6/n3 ratios in milk were higher than those recommended by WHO, those are 5/1- 10/1 (Bouattour *et al.*, 2008). Fatty acid in feces followed the pattern shown in concentrate and milk. Based on the relatively high in C<16, C>16, unsaturated, n-6/n-3, and total fatty acid in milk, the 5% fermented Durio peel flour in concentrate is considered a reasonable level to be provided in the diet of dairy goat.

Most of the fatty acid amounts (g of fat) found in concentrates, milk, feces, and fatty acid digestibility were found very significantly high ($p$<0.01) in 5% fermented Durio peel flour concentrate (Table 6). It seemed that there were synergic effects of roasted ground corn, roasted soybean meal as feed ingredients; yeast and *Curcuma xanthorrhiza* as well as fermented Durio peel flour that was optimal in 5% level as feed supplements in improving the nutrients of feed, nutrient intakes and digestibility as well as fatty acid contents in concentrate, milk then disposed of in feces.

Table 6. Fatty acids balance of concentrate, milk, feces and digestibility of dairy goat fed diet with concentrate containing fermented Durio peel flour

| Fatty acid (g of fat) | FDC 0 | FDC 5 | FDC 10 | FDC 20 | SEM |
|---|---|---|---|---|---|
| Concentrate | | | | | |
| C<16 | 9.13$^{a}$ | 28.66$^{b}$ | 27.06$^{b}$ | 27.37$^{b}$ | 5.77 |
| C>16 | 229.40$^{a}$ | 464.21$^{b}$ | 444.81$^{b}$ | 399.06$^{b}$ | 1.56 |
| Unsaturated | 28.32$^{a}$ | 61.00$^{b}$ | 46.81$^{b}$ | 34.94$^{b}$ | 8.93 |
| n6/n3 | 1.69$^{a}$ | 2.98$^{b}$ | 3.10$^{b}$ | 3.43$^{b}$ | 2.17 |
| Total FA | 34.84$^{a}$ | 98.57$^{b}$ | 78.53$^{c}$ | 71.63$^{c}$ | 2.77 |
| Milk | | | | | |
| C<16 | 19.06 | 27.22 | 24.89 | 26.12 | 7.22 |
| C>16 | 29.33 | 32.04 | 29.81 | 30.01 | 14.40 |
| Unsaturated | 20.38 | 22.11 | 18.58 | 20.40 | 9.12 |
| n6/n3 | 7.55 | 8.06 | 9.13 | 8.22 | 4.24 |
| Total FA | 73.29 | 75.07 | 73.37 | 74.02 | 2.46 |
| Feces | | | | | |
| C<16 | 0.59$^{a}$ | 0.60$^{a}$ | 0.89$^{b}$ | 0.61$^{a}$ | 0.05 |
| C>16 | 3.07$^{a}$ | 2.77$^{a}$ | 4.22$^{b}$ | 2.88$^{a}$ | 0.23 |
| Unsaturated | 0.57$^{a}$ | 0.35$^{b}$ | 0.42$^{b}$ | 0.40$^{b}$ | 0.03 |
| n6/n3 | 1.94$^{a}$ | 1.89$^{a}$ | 1.92$^{a}$ | 1.45$^{b}$ | 0.12 |
| Total FA | 3.68$^{a}$ | 3.40$^{a}$ | 5.14$^{b}$ | 3.51$^{a}$ | 0.28 |
| Digestibility | | | | | |
| C<16 | 93.59$^{a}$ | 97.89$^{b}$ | 96.69$^{b}$ | 97.76$^{b}$ | 0.26 |
| C>16 | 90.60$^{a}$ | 95.87$^{b}$ | 93.20$^{c}$ | 94.11$^{b}$ | 1.24 |
| Unsaturated | 97.97$^{a}$ | 99.42$^{b}$ | 99.10$^{b}$ | 98.85$^{ab}$ | 0.07 |
| n6/n3 | 14.60$^{a}$ | 34.31$^{b}$ | 36.52$^{b}$ | 57.14$^{c}$ | 12.65 |
| Total FA | 89.44$^{a}$ | 96.55$^{b}$ | 93.46$^{c}$ | 95.09$^{c}$ | 0.41 |

Different superscripts of means in the same row, different very significantly ($p$<0.01)

## CONCLUSION

Based on analyses, there was found that the 5% fermented Durio peel flour in concentrate showed several consistency in some quality. Those were high in crude protein, ether extract, dry matter intake, gross energy, digestibility of nutrients (dry matter, organic matter, ether extract, crude protein, crude fiber, N-free extract, gross energy), milk yield, ECM, MCFA, LCFA, PUFA in milk, C<16, C>16, unsaturated, a total fatty acid in concentrates, milk, and feces. There were some low SCC in milk and low in n-6/n-3 in milk. Therefore, the 5% fermented Durio peel flour and 25% of rice bran in concentrate was considered optimal for lactating dairy goat.

## CONFLICT OF INTEREST

The authors whose names are listed have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

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